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PERSONALITY AS A VARIABLE IN THE BEHAVIOR OF BIRDS[1]

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ABSTRACT

Investigations with Common Grackles, Red-winged Blackbirds, Brown-Headed Cowbirds, and Starlings indicate the importance of what is called personality in the interpretation of bird behavior. These studies were carried out in connection with a banding program at a decoy trap. An objective test of the characteristic called complacency reveals Cowbirds to be the most complacent and Starlings the most agitated. A rating scale for aggressiveness, based on the reaction of a bird in the hand to a standardized series of threatening gestures, reveals Grackles and Cowbirds to be the most aggressive and Starlings and Red-wings the least aggressive. Grackles have the greatest tendency to "repeat", i.e., re-enter the trap. Recoveries of banded birds by other persons indicate that Grackles have the largest incidence of local recoveries, presumably due to topophilia. The Grackle population is much more stable (e.g. has more individuals remaining in area for 10 days or more) than are the populations of other species. A larger proportion of Grackles was trapped in a residential area and a smaller proportion in an agriculutral area. In a roost-control operation, more banded Grackles were collected than might be expected from the comparative sizes of the populations of the different species trapped at that time of year.

INTRODUCTION

When a blackbird roost developed in 1963 in a woodlot on the University Farm in Columbus, Ohio, a large decoy trap was built nearby and an extensive banding program undertaken. Data obtained in this program implemented a number of research projects on the movements and migrations of birds. Some birds made available by the program were used in various behavioral studies. Our respective backgrounds in Psychology and Zoology tended to broaden the scope of this research. Now, eight years and 100,000 banded birds later, we have become convinced of the importance of what we call personality of the birds (as defined in a later section) as a variable in the interpretation of bird behavior. The present

NEW EDITOR

With this issue, the present Editor of *The Ohio Journal of Science* lays down her pencil and hands over the responsibilities to the new Editor, who is **Dr. David K. Webb.** Address of the new editorial offices will be: *c/o Division of Geological Survey, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio 43224.* All manuscripts being submitted, reviews being returned, and other editorial correspondence should be sent to this new address, effective immediately.

[1]Manuscript received January 3, 1972.

article brings together a considerable amount of our research material in support of this conviction.

THE RESEARCH FACILITY

The decoy trap (Burtt and Giltz, 1971a) is 80 feet long, 40 feet wide, and seven feet high, and is built of chicken wire and plastic netting. On the top are two sections 30 feet by three feet in size, consisting of turkey wire with a two-by-four-inch mesh. Birds of moderate size can fold their wings and drop through these small openings, but cannot fly out through them with wings extended. Inside the trap are cracked corn, pans of water, and at least ten live birds (decoys). The operator enters a door at one corner and drives the birds across the trap and down a tapering runway into a gathering cage, where the birds are banded, on the tarsi, with numbered bands provided by the U. S. Fish and Wildlife Service, and then released. Records are kept both of the bandings and of the identities of birds caught in the trap.

The birds captured and banded in the present study are for the most part the Common Grackle (*Quiscalus quiscula*), the Brown-Headed Cowbird (*Molothrus ater*), the Red-Winged Blackbird (*Agelaius phoeniceus*), and the Starling (*Sturnus vulgaris*). Mourning Doves (*Zenaidura macroura*) were also included in the project evaluating aggressiveness.

NATURE OF PERSONALITY

A person who has numerous contacts with birds at a banding station becomes impressed by the behavioral differences between individuals. One bird lies quietly in the hand, but another bites the fingers. In the decoy trap, one rests quietly on a perch while another flies rapidly back and forth, or one sits alone on the ground while another joins a group. When released after being banded, one is last seen as a speck against the horizon, but another goes back into the trap almost immediately. Such differences are observable between individuals of the same species and also between species.

In attempting to classify these behavioral differences, it proved meaningful to use such terms as intelligence, memory, learning ability, quickness in reacting, aggressiveness, persistence, dominance, emotionality. These terms, or the variables to which they refer, fall into two large behavioral categories. Intelligence, memory, learning ability, and quickness in reacting involve what a bird *can* do. Aggressiveness, persistence, dominance, and emotionality involve what a bird *will* do. To cite more specific examples, the first category relates to how fast *can* the bird fly and the second category relates to whether it *will* fly away from or toward an adversary. Similarly, in the first category is how hard *can* it bite (in grams) and in the second category is *will* it bite an adversary or the bander's fingers. The "can do" category is termed *aptitude* or ability and the "will do" category is termed *personality*. We have made this distinction elsewhere (Burtt and Giltz, 1969b), but in the present article are concerned mainly with personality.

PERSONALITY FACTORS REPORTED BY STUDENTS OF ANIMAL BEHAVIOR

Personality has been used for many years as a category of human behavior. It can be considered likewise as a category of animal behavior, without anthropomorphic implications, provided it is defined objectively and operationally. The actual term "personality" is used sparingly in the literature on animal behavior. Harlow, with rhesus monkeys, states that "personality factors could operate to produce performance differences" (Harlow, 1971, p. 543). The more common practice is to mention specific personality traits of animals, such as aggressiveness, emotionality, temperament, or self confidence, without reference to the overall category to which they belong.

In the field of personality, most of the experimental work of ornithologists deals with peck order and the aggressiveness or dominance involved (Ellis, 1966). Otherwise most of the literature is anecdotal. Robins (*Erithacus rubecula*) differ individually in tendency to attack a stuffed model (Lack, 1964). An emotionally unstable Song Sparrow (*Melospiza melodia*) dies of fright (Peterson, 1963, p. 138). One Penguin is sufficiently tame to stand still when a man approaches, while another attacks (Murphy, 1936). Some Carolina Wrens (*Thryothorus ludovicianus*) give distress calls when handled by a bander, while others always remain silent (Norris, 1965).

Tinbergen and Lorenz (Tinbergen, 1953, 1954, 1961; Lorenz, 1952), on the basis of extensive observations of bird behavior, report individual and species differences that may be construed as personality differences, according to the definition given above. They use such terms as "self possessed," "self assertive posture," "fighting urge," "boldest," "personal courage," "self assurance," "vivacious," "boredom," "timid," and "fierce."

In the foregoing instances, although the ornithologists do not use the actual term "personality," they are discussing the "will do" type of behavior, which we call personality. A main function of the present discussion is to both define and describe bird personality so as to give it a status comparable to human personality as an explanatory principle.

THE COMPLACENCY-AGITATION CONTINUUM

Two aspects of personality in birds are their complacency and their aggressiveness, related traits which were evaluated independently in connection with the banding program mentioned above. Complaceny was studied in an objective testing situation and aggressiveness was evaluated by a rating scale approach. Also reported on here are the results of several other investigations that were not initially oriented toward personality, but where personality aspects emerged in the interpretation of the results. These investigations were: re-entries or repeats at the decoy trap; recoveries of banded birds by persons other than the bander; population stability; captures in residential *vs.* agricultural areas; species killed in a blackbird-control project.

Sometimes when an empirical correlation is found between two variables, it does not imply causality. There may be an intervening variable that is causally related to both the initial variables. In some of the studies just mentioned personality may be such an intervening variable.

Method

A study of the complacency-agitation continuum was carried out with a total of 550 birds as follows. Immediately after being banded, the bird was placed in an observation cage 18 by 24 inches in area and 24 inches high, made of screening with a half-inch mesh (hardware cloth). A perch, consisting of a half-inch dowel rod, extended across the middle of the cage 12 inches above the floor. During the investigation, the cage was placed on a bench near the banding area, and the observer sat 20 feet distant behind a car, watching through the two rear windows, or sat in a small utility building watching through the window. There was no indication that the bird paid any attention to the observer.

The birds sat on the perch or the floor, or moved about on the perch, the floor, or the four sides of the cage. This behavior was noted, in as much detail as possible, with the aid of a tape recorder. In this record, the observer used such words as "perch," "turn," "side-step," "floor still," "floor active," "south wall." When the tape was replayed, the observer, noting a stop-watch, recorded the duration of each type of behavior. The bird was observed for a period of 100 seconds, followed immediately by another period of 100 seconds. The two trials were subsequently correlated to determine the reliability of the test, as discussed below.

Several methods of scoring the test were explored by determining the reliability of each. The following pattern was finally adopted because of its adequacy in this respect.

Complacency score = C+T+S+FA+W, where
C = number of changes of location such as from perch to floor,
T = number of 180° turns made on perch,
S = number of times the bird stepped or hopped sidewise on perch,
FA = time (in seconds) active on floor, and
W = total time on walls of cage.

Scoring of these behavioural patterns involved their frequency, or their duration, in seconds, during the period of observation. A small score indicated greater complacency and a large score greater agitation. The data were gathered throughout the year, except in winter, and always in the early afternoon (Burtt and Giltz 1969a).

Reliability

Standard practice determines the reliability of a psychometric device by applying it twice to the same individuals and correlating the two sets of scores. If each individual makes about the same score on both occasions, the instrument is considered to be reliable in the sense that it apparently actually indicates the individual's capability. If the two scores made by an individual are markedly different, it is impossible to tell which score represents his capability. A common variation of this procedure is to give a single test, split it at the middle, and correlate the first half with the second half. This procedure is followed with the present data by correlating scores for the first 100 seconds with scores for the second trial of 100 seconds. The products-moments correlation (r) is .83. Actually this is the reliability of a 100-second test. To correct this to determine the reliability of the 200-second test, it is necessary to use the Spearman-Brown formula 2 r/1+r (Dunlap and Kurtz, 1932, p. 127). The result is a relability of .91, which compares favorably with the reliability of human psychological tests used in schools and industries.

Results—Species Differences

Comparison of the mean complacency scores for different species (Table 1) reveals that Cowbirds are the most complacent (smallest mean score) and Starlings are the most agitated, with Grackles and Red-wings intermediate. A t-test applied to the various differences between means indicates that the Grackles and Red-wings do not differ significantly ($p > 0.05$), but that all the other differences between means are significant ($p < 0.01$).

If distribution curves are plotted with complacency scores on the abscissa and frequencies, as percentages, on the ordinate, the species curves are essentially normal, except for the Cowbird curve which is skewed toward the low scores. Inasmuch as the t-test assumes normality of distributions, the precaution is taken of comparing the actual Cowbrid distribution of complacency scores with the distributions for the other three species by the use of Chi-square. For all three comparisons, the differences in distributions are significant ($p < 0.01$).

The occurrence of Cowbirds and Starlings at the extremes of the complacency-agitation continuum corresponds very well with their observed behavior in the decoy trap. Cowbrids sit quietly on the perches provided or on the ground, while Starlings fly back and forth or cling to the sides of the trap.

Results—Sex Differences

A comparison of the differences in complacency for the two sexes in Cowbirds and Red-wings (Table 1) reveals that, in both species, the females are more complacent than are the males (smaller mean score). However, for the Cowbirds the difference between means is not significant ($p > 0.05$). With the Red-wings, the difference is significant ($0.05 > p > 0.01$). Comparison of the actual distributions, as described in the preceding section, for males *vs.* females does not yield a significant difference for either species. Thus there is some suggestion of greater complacency on the part of female Red-wings in comparison with males.

TABLE 1

Species, sex, and age differences in complacency scores

	Number of Birds	Mean Complacency Score[1]
Cowbird	127	65
Grackle	148	133
Red-wing	166	137
Starling	109	160
Male Cowbird	92	67
Female Cowbird	35	59
Male Red-wing	126	144
Female Red-wing	40	116
[2]AHY Male Red-wing	77	84
[3]HY Male Red-wing	77	112
AHY Male Cowbird	78	76
HY Male Cowbird	78	96

[1]Small score most complacent; large score most agitated.
[2]AHY = after-hatching year
[3]HY = hatching year.

It is possible that a high degree of complacency is advantageous to a female bird in incubating eggs and raising young, and has some survival value for the nestlings. Hence a genetic sex difference in complacency might develop in the course of evolution. It should be noted that, in the present data, the Cowbird females, with no incubation and nest maintenance activities, do not differ from the males in complacency, while the Red-wing females do differ from the males to some extent. Sex differences in complacency were not investigated with the other species.

Results—Age Differences

Differences in complacency for certain age groups were also investigated (bottom portion of Table 1). The notations follow those used in the Bird Banding Manual (U. S. Dept. of the Interior, 1972). A bird banded in the same calendar year in which it was hatched is called HY (hatching year) and one banded in a calendar year subsequent to that in which it was hatched is AHY (after hatching year).

Matched samples of AHY and HY birds were selected at the time of testing. For example, if the gathering cage contained several AHY male Red-wings and several HY male Red-wings, one of the former would be tested for complacency and immediately thereafter one of the latter. This sample selection minimized contaminating variables, such as seasonal factors, circadian rhythms, or weather. The study was limited to males of the two species, because the number of matched pairs of female Red-wings was inadequate for statistical purposes and the identification of the age of female Cowbirds was unreliable.

The mean for the AHY male Red-wings (84) is less than that for the HY males and the difference is significant ($0.05 > p > 0.01$). Similarly with the Cowbirds, the AHY males are significantly more complacent than are the HY males ($0.05 > p > 0.01$). Frequency distribution curves for the two ages and species appear in Figures 1 and 2, where complacency scores are on the ordinate. In both cases, the Red-wings (fig. 1) and the Cowbirds (fig. 2), the two curves involve the same number of birds and thus are directly comparable.

The distribution curve for the AHY Red-wings (fig. 1) is somewhat to the left of the HY curve, indicating greater complacency for the AHY birds. A Chi-square test shows that the difference between distributions is just significant ($p = 0.05$). Figure 2 gives similar distributions for the Cowbirds, but the difference between distributions is not significant ($p > 0.05$). Thus the data show greater complacency on the part of the older birds, but the age difference is more important in the Red-wings than in the Cowbirds.

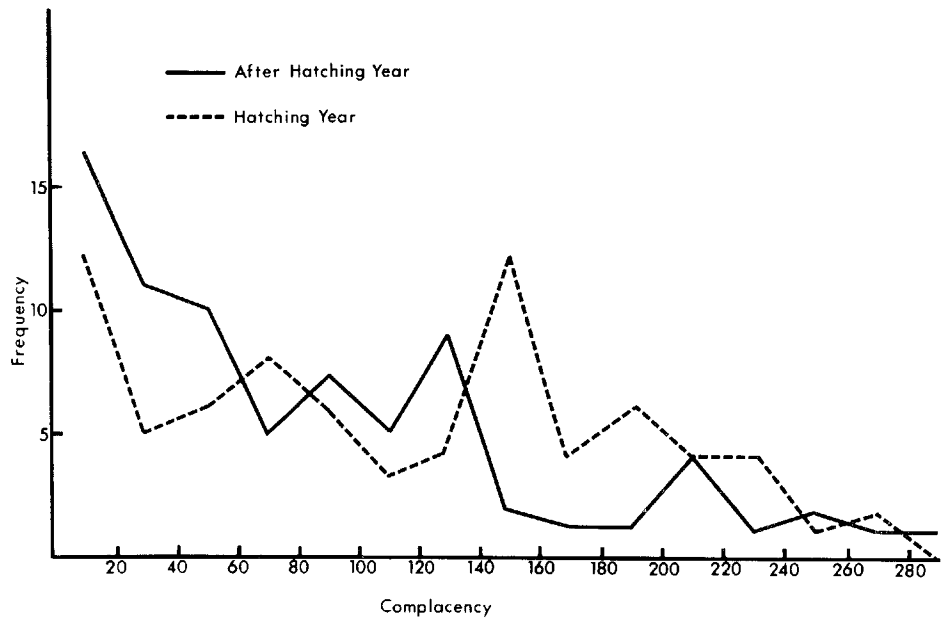

Figure 1. Complacency scores for two age groups of male Red-winged Blackbirds.

Agitation on the part of a young bird may produce more vigorous begging for food and improve its chances for survival. As the survivors get older, the agitated behavior may become less advantageous and thus may decrease because of disuse.

Results—Seasonal Differences

With the Red-wings, it was possible to study seasonal differences in complacency. It was not profitable to use mean scores for each month, because some of the samples were too small, so the entire sample was divided arbitrarily at the midpoint of the sampling period into two equal samples. This produced an earlier sampling consisting of Red-wings banded from July 5 through October 8 and a later sample consisting of Red-wings banded from October 9 through November

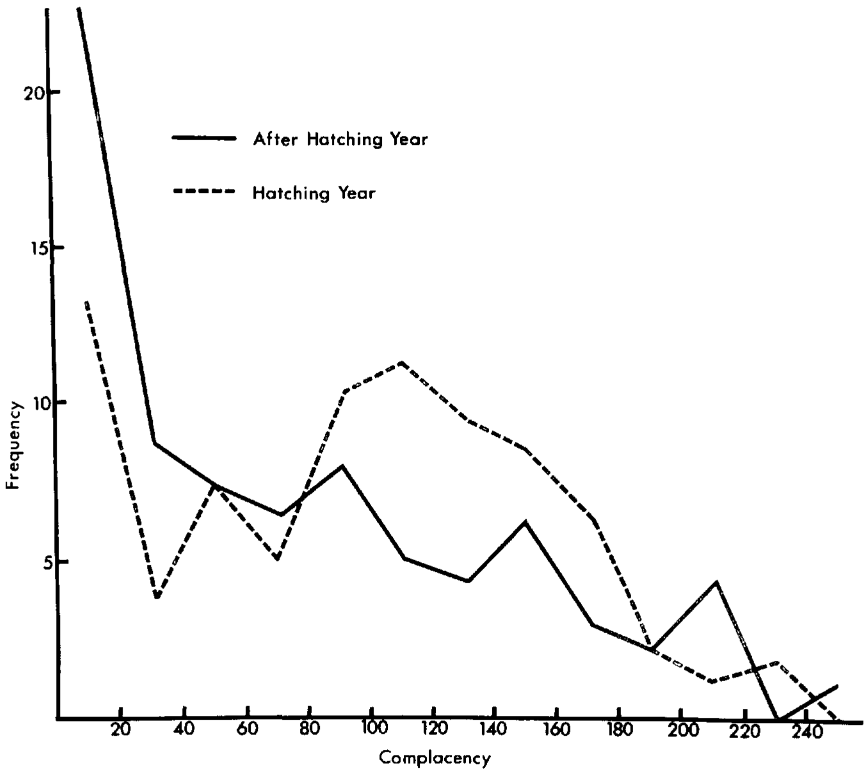

Figure 2. Complacency scores for two age groups of male Cowbirds.

12. Each sample comprised 39 AHY's and 39 HY's. October 9 is fairly close to the beginning of the fall migration in this region.

Of the mean complacency scores for the two groups (Table 2), the mean for the earlier period is the smaller (more complacency) and the difference is significant ($p<0.01$). Curves for the frequency distributions in complacency for the two seasonal samples are given in Figure 3, which shows the curve for the late season farther to the right (greater agitation). The two distributions differ significantly ($0.05>p>0.01$).

Testing of the late-season sample occurred for the most part during migration period. There is considerable evidence that this period is characterized by "mi-

TABLE 2

Seasonal differences in complacency scores for red-wings*

	Number of Birds	Mean
Early Season	78	73
Late Season	78	124

*Low score most complacent; high score most agitated.

gratory restlessness"—*Zugunruhe* (Welty 1962, p. 468). Such restlessness may be much the same thing as the agitation measured in the present investigation.

AGGRESSIVENESS

The measurement of complacency just discussed is somewhat analogous to the personality tests used in schools or industries. Another approach to such measurement in these agencies is a rating scale. An analogous scale was developed for rating the aggressiveness of birds.

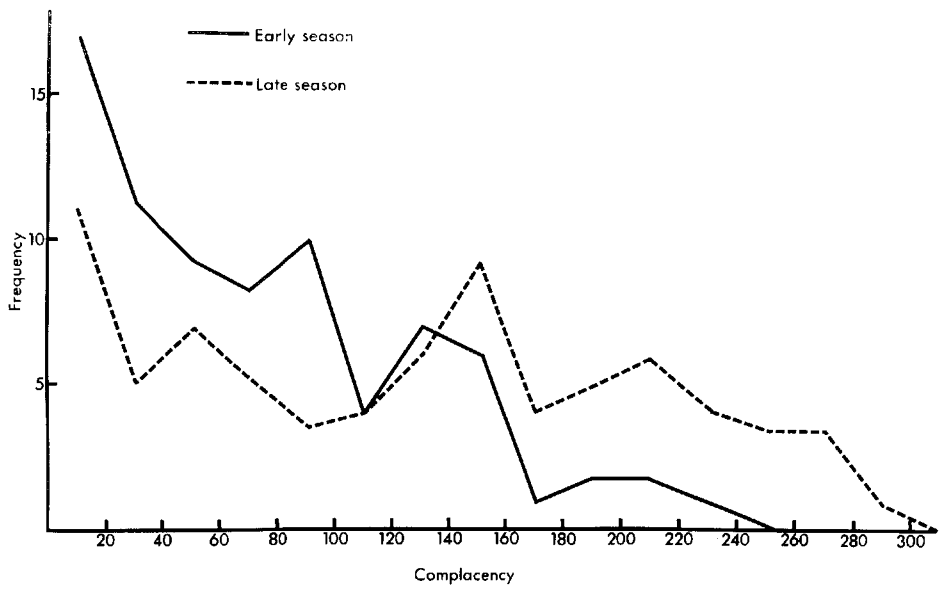

Figure 3. Complacency scores for male Red-wings tested early (July 5-Oct 8) and late (Oct 9-Nov 12) in season.

Methods

It was desirable to judge aggressiveness in a standard situation that could be duplicated for all the birds. Such a practical situation of this sort was holding the bird in the hand, threatening it and judging aggressiveness largely on the basis of its biting behavior. After some preliminary investigation, the following procedure seemed adequate from the standpoint of eliciting individual differences, and was adopted.

The bird was held in the left hand with its back toward the palm and facing upward. Its legs were grasped by the right hand as a precaution against escaping. Then the fingers of the left hand were opened. After 10 seconds the bird was threatened with the middle finger of the left hand for 10 seconds, then threatened with the left thumb for 10 seconds, and then threatened from the front with the middle finger of the right hand for the final 10 seconds. The observer equated the overall behavior of the individual bird during the 40-second period with some particular statement in the following scale and assigned the bird the corresponding aggressiveness score. All the ratings in the present study were made by one observer (Burtt).

10 Spontaneously begins biting rapidly and vigorously the moment the hand is opened and continues for the 40 seconds.

9 Spontaneously bites rapidly and vigorously, but does not begin immediately when the hand is opened.

8 Spontaneous but less vigorous biting continuously through most of the initial period.
7 A few spontaneous bites, followed by rapid and vigorous biting when threatened.
6 Quiet during the initial 10 seconds, but rapid and continuous biting when threatened.
5 Several vigorous bites at each threat, but not a continuous attack.
4 Some biting at each threat, but not vigorous.
3 No biting until the last threat, but several bites thereafter.
2 A single bite on the last threat.
1 No biting whatever; completely passive.

Reliability

The reliability of the scale was determined with a sample of 100 Cowbirds and 100 Grackles. After a bird taken from the gathering cage had been banded and rated, it was placed in a supplementary cage. Presently each bird was taken from the supplementary cage and rated a second time without consulting the first rating. The interval between ratings was on the order of 15 minutes. The correlation between the two ratings for the 200 birds is 0.82, which compares favorably with the reliability of rating scales used at the human level.

Results—Species Differences

Sampling of Mourning Doves (*Zenaidura macroura*), Starlings, Red-wings, Cowbirds, and Grackles were rated in the manner just described. Results (table 3)

TABLE 3

*Species differences in aggressivness scores**

	Number of Birds	Mean Aggressiveness Score
Mourning Dove	100	1.00
Starling	400	1.64
Red-wing	400	1.80
Cowbird	831	2.96
Grackle	911	2.95

*Low score indicates low aggressiveness; high score high aggressiveness.

show that Cowbirds and Grackles are the most aggressive and Mourning Doves the least aggressive, with Starlings and Red-wings intermediate. Actually every Mourning Dove received a rating of 1. In cases where a bird was rated more than once, for some other study, only the initial rating is given in Table 1. A t-test indicates that the Cowbirds and Grackles do not differ significantly ($p>0.05$), nor do the Starlings and Red-wings differ significantly ($p>0.05$). For all the other combinations of species, the means differ significantly ($p<0.01$). As a further check, the differences between species distributions were evaluated by Chi-square. The results are exactly the same as the foregoing, i.e., no significant difference for either Cowbird and Grackle distributions or for Starling and Red-wing distributions, but significant differences for all the other combinations.

Results—Individual Differences

In addition to species differences, the rating scale is also sensitive to individual differences. A direct approach to such individual differences was possible with

Grackles and Cowbirds, where a given bird re-entered the trap and was rated many times. From the several ratings given to an individual bird, its average rating was obtained and the variability in its ratings (the variance "within" the bird) determined. Similarly averages for the different birds were compared (variance "between" birds). A simple analysis of variance determined the ratio (F) of the variance between birds to the variance within birds. For Grackles, F is 4.4, where 2.0 suffices for $p<0.01$, and for Cowbirds, F is 21.6, as against a requirement of 2.2. Obviously, for those two species, the aggressiveness rating scale brings out the individual differences. Incidentally, the correlations between aggressiveness ratings and complacency measurements is about 0.10. These two personality traits are orthogonal (Burtt and Giltz 1969b).

TENDENCY TO RE-ENTER THE DECOY TRAP

In addition to these two studies of specific personality characteristics, five other projects connected with the banding program provided additional information about personality. These were projects dealing with re-entries or repeats at the decoy trap, recoveries of banded birds by others, population-stability studies, captures in residential *vs.* agricultural areas, and species killed in a blackbird-control project. The projects were not initially oriented toward personality, but, in the course of analyzing the results, the role of personality became apparent.

Clarification of some of the terms used in connection with these projects may be helpful at this point. Some banded birds re-enter the trap one or more times; if the re-entry occurs less than 90 days after its first entry, i.e. after the date of banding, the bird is termed a "repeater" and each re-entry is called a "repeat." If a bird re-enters the trap five times, the records show one repeater and five repeats. If the interval between banding and re-entry is more than 90 days, the bird is termed a "return." Some banded birds are found by other persons and reported to the Wildlife Service, which in turn notifies the bander; these cases are termed "recoveries."

Results—Species Differences

Species differences in tendency to repeat were analyzed with samples in 1965 and 1968 (Burtt and Giltz, 1970a). Data for the 1968 sample appear in Table 4,

TABLE 4
Species differences in repeating in 1968

	Grackle	Cowbird	Red-wing	Starling
Number banded	2,685	2,138	5,728	3,661
Repeaters	490	246	295	49
Repeaters/number banded	0.18	0.12	0.05	0.01
Repeats	2,107	619	821	55
Repeats/number banded	0.78(0.79)*	0.29(0.27)*	0.14(0.11)*	0.01(0.03)*

*Figures in parentheses are from similar sized sample in 1965.

together with some values from 1965. The first line gives the number of each species banded during the year. The second line gives the number of repeaters. These repeaters can best be interpreted by taking them as a ratio to the number banded (third line). Grackles have proportionately the greatest number of repeaters, followed by Cowbirds, Red-wings, and Starlings in that order. The fourth line gives the number of repeats and the fifth line relates this number to the number banded. Here again the Grackles have comparatively the most repeats, followed by the other species in the same order as for repeaters.

These results are statistically significant. For the repeaters, Chi-square has been applied to the entries in the second line, including, of course, the non-repeaters. Chi-square is 746 where 11.3 suffices for $p<0.01$. For the repeats, the figures in line 4 are based on frequency distributions for one repeat, two repeats, etc. The ratio (F) of the variance between species to variance within species is 8.8 where 3.8 suffices for $p<0.01$. As an additional precaution, frequencies are determined for no repeats, one repeat, two repeats, and "more than two repeats." Chi-square applied to these frequencies is 762 where only 21.6 is needed for $p<0.01$.

The 1965 sample yields results very similar to those just described. Some excerpts from the 1965 data appear in parentheses in the last line of Table 4. For example, the ratio of repeats to number banded for Grackles is .78 in 1968 and .79 in 1965, and the ratios for the other species in the two samples are also quite similar.

Contaminating Variables

Two possibly contaminating variables should be considered before attempting an explanation of the species differences in tendency to repeat. The first such variable is the season or time of year when the repeating occurs. When the ratio of number of repeats to number banded is plotted on the ordinate against months of the year on the abscissa for each species, the curves run parallel and do not cross each other. In other words, the Grackles' tendency to repeat is greater than that of the other species throughout the year; the Cowbirds' tendency is consistently greater than that of the Red-wings throughout the year, and the relationships are similar for the other species. The seasonal variable apparently does not contaminate the demonstrated species differences in tendency to repeat.

The other possibly contaminating variable is food preference. The cracked corn used as bait may not attract the Starlings as much as it does the other species. Studies of stomachs or crops of birds, with the contents classified as "plant" or "animal," indicate a comparatively smaller proportion of plant food for Starlings—something on the order of 40 percent "plant," as against 65–75 percent for the other species (Martin, Zim, and Nelson, 1961). If these figures truly reflect food preference, then eating the corn may produce less reinforcement for Starlings than for other species that enter the trap, and make them less inclined to re-enter. On the other hand, if Starlings can recognize the corn from outside the trap, this should minimize initial entry, which it apparently does not. The first line of Table 4 shows that 3,661 Starlings entered the trap in 1968, a value exceeded in number only by the Red-wings. Contamination of the data by differential food preference appears to be minimal.

Learning Trap Avoidance

One possible explanation of the differences in tendency to repeat is differences in learning to avoid the trap. If Grackles, for example, are slowest in learning trap avoidance, they will be inclined to re-enter the trap more frequently than do the other species. However, on theoretical grounds, there is considerable doubt about a bird's learning trap avoidance at all—with a decoy trap. Learning depends on reinforcement (positive or negative) and is most effective when the reinforcement follows the response (entering the trap) by the shortest possible time interval (Wickens and Meyer, 1955, p. 66). With traps of the Potter type, the bird enters the door and steps on a platform which operates a mechanism to close the door immediately. This is frightening to the bird, and because the immediate negative reinforcement is associated with the act of entering, the bird learns not to enter. With the decoy trap, on the contrary, when the bird enters, negative reinforcement (confinement, fear) does not occur until somewhat later and so is not associated with the act of entering. If there is any immediate reinforcement, it is positive (food, companions) and makes for learning to re-enter rather than to avoid the trap. Thus, it is doubtful if learning trap avoidance is sufficienct to explain the species differences noted above.

Personality

A more probable explanation for the species differences in repeating, in the judgment of the writers, lies in some aspect of the bird's personality. One such aspect is the complacency-agitation continuum discussed earlier. Starlings are at the agitation end of the continuum and also do the least repeating. The agitation may lead them, when banded and released, to leave the vicinity rapidly and to go farther, thus reducing the probability of their returning to the trap. Another of our studies (unpublished) revealed that, when banded and released, Starlings flew a greater distance before alighting than did Red-wings or Cowbirds.

Another pertinent aspect of personality is social inclination. The decoys' main function is to move about and attract the attention of birds overhead. However, the decoys also act as social stimuli. The birds flying over drop down to the trap to investigate, are socially stimulated, become inclined to join the decoys, notice the apertures in the wire mesh, and drop through. Species and individuals may differ in this social inclination. In addition, when entering the trap, the social contacts may have a reinforcing effect and tend to make this behavior more habitual, especially with birds that are initially the most socially oriented. Doubtless there are other as-yet-unexplored aspects of bird personality that may contribute to the explanation of repeating behavior.

Results—Sex Differences

Sex differences in the tendency of Red-wings and Cowbirds to repeat were recorded for four different years: 1965, 1968, 1969, and 1970 (Table 5). The first two columns of the table give the sizes of the samples, i.e., the number of birds banded. The third column gives the number of male repeaters divided by the number of males banded, and just below it the number of male repeats divided by the number of males banded. For example, for Red-wings in 1965, there were 394 male repeaters (not shown). Dividing this by 5,886 gives .067 in the third column, first line. There are 590 repeats by these same birds (not shown) and this divided by 5,886 gives .100 in the third column, second line. The fourth column gives similar data for the females in each sample.

The ratios for the females are larger than are those for the corresponding males in all the 16 cases shown in Table 5. Two checks were made as to the significance of these sex differences. For the data on repeaters, Chi-square was applied to the number of repeaters and non-repeaters of both sexes. Also the critical ratio was computed, i.e., the difference between the two proportions (ratios) shown divided by the standard deviation of this difference. For the data on repeats, Chi-square was applied to the number of banded birds of each sex with one repeat, with two repeats, and with more than two repeats, and the critical ratio was also computed as just described for the repeaters. The results of these two checks appear in the last two columns of the table.

In the first two samples shown in the table, the sex differences for repeaters are not significant. All the other differences are significant, at least beyond the 5 percent level, and most of them beyond the 1 percent level. According to these data, female Red-wings and Cowbirds appear to have a greater tendency to repeat than do males.

The explanation of these sex differences in repeating probably involves aspects of personality, as was the case with species differences. The females may have greater complacency than do the males, which leads them, when released, to remain in the vicinity of the trap and hence to re-enter with greater frequency. The females may be more socially inclined and, when they drop down to the top of the trap to investigate, may become more interested in entering to join the decoys. Female Red-wings and Cowbirds have been observed by us soliciting the attention of males during the breeding season. Conceivably this behavior may involve a personality characteristic that operates also at other times of the year and leads the females to "pursue" or "seek" the males that are available in the trap.

TABLE 5

Sex differences in the tendency to repeat

	Number Banded		Repeaters/ Number Banded and Repeats/ Number Banded		Significance of Differences	
	Male	Female	Male	Female	By Chi-Square	By Critical Ratio
1965						
Red-wing repeaters	5,886	720	0.067	0.085	0.10>p>0.05	p=0.07
Red-wing repeats			0.100	0.222	0.02>p>0.01	p<0.01
1968						
Red-wing repeaters	3,784	2,571	0.046	0.056	0.10>p>0.05	p=0.07
Red-wing repeats			0.112	0.247	p<0.01	p<0.01
1969						
Red-wing repeaters	4,146	1,211	0.048	0.064	0.05>p>0.02	p=0.03
Red-wing repeats			0.147	0.273	p<0.01	p<0.01
1970						
Red-wing repeaters	3,979	1,521	0.054	0.084	p<0.01	p<0.01
Red-wing repeats			0.147	0.314	p<0.01	p<0.01
1965						
Cowbird repeaters	2,898	716	0.113	0.190	p<0.01	p<0.01
Cowbird repeats			0.214	0.490	p<0.01	p<0.01
1968						
Cowbird repeaters	1,425	559	0.095	0.184	p<0.01	p<0.01
Cowbird repeats			0.225	0.506	p<0.01	p<0.01
1969						
Cowbird repeaters	3,926	1,011	0.120	0.220	p<0.01	p<0.01
Cowbird repeats			0.289	0.826	p<0.01	p<0.01
1970						
Cowbird repeaters	4,280	1,407	0.146	0.237	p<0.01	p<0.01
Cowbird repeats			0.286	0.527	p<0.01	p<0.01

RECOVERIES OF BANDED BIRDS

Many of the birds banded by us are "recovered" by someone else who then, hopefully, reports the band number to the Wildlife Service. The Service then notifies us where and when the birds were recovered. This program implements studies of migration routes and of longevity. In the present context, it also throws some light on behavior variables. Data are available for 56,246 birds banded in 1964–1968 inclusive that yielded 958 recoveries (Burtt and Giltz, 1969c).

Locations of recovery sites, relative to Ohio, are given for the four main species of birds in Table 6. The successive columns give, for each species, the number of recoveries, the percent of these recoveries that were made outside Ohio, the percent made in Ohio outside of Columbus, and the percent that were local, i.e., within the city limits of Columbus. The most striking item in the table is the 80 percent local recoveries for Grackles. This percentage differs significantly from each of the other percentages in the column ($p<0.01$).

This result suggests that Grackles have an orientation or attraction toward the local area (*topophilia*) to a greater extent than do the other three species (Burtt and Giltz, 1970b). Further evidence of topophilia is found in an analysis of "returns" of banded birds. As defined earlier, a return is a bird re-trapped 90 days or more after having been banded. Most returns are in a calendar year subsequent to the year of banding. In the present study, about 4½ percent of the banded Grackles returned, as contrasted with less than 1 percent for each of the other species. Chi-square indicates that Grackles differ significantly from each of the others. In an earlier section, it was shown that Grackles tended to re-enter the trap (in the same season when banded) with greater frequency than did the other species. Now it appears that they show the same trend in a subsequent season—a further indication of topophilia.

TABLE 6
Recoveries of banded birds

	Number of recoveries	% Recovered outside Ohio	% Recovered in Ohio outside Columbus	% Recovered within Columbus
Grackles	118	6	14	80
Cowbird	156	60	22	18
Red-wing	55	40	35	25
Starling	629	32	34	34

The reasons for species differences in this aspect of personality are not entirely clear. There may be differences in the tendency to become imprinted to a local area, or in susceptibility to reinforcement when returning to a local area. There is also the possibility that topophilia is merely an intervening variable and the basic factor is some other aspect of personality, such as a preference for, or a favorable attitude toward, things that are familiar.

POPULATION STABILITY

A stable population is one in which many of the same birds are present in the same vicinity on numerous days during a given period. Data on "repeats" implement the computation of a *stability index* (Burtt and Giltz, 1969d). This index merely counts the birds known, or assumed, to be present on a given day that have been in the area for at least 10 days. The selection of 10 days is arbitrary, but it provides a reasonable continuity and empirically it does reveal species differences. A bird is "assumed to be present" in the vicinity on each day between initial banding and the first repeat and also on each day between subsequent repeats.

The following oversimplified example shows the method of computation. Each lettered row represents an individual bird and each numbered column a date. A check mark indicates initial banding, an X is a repeat, and a dash means that the bird is assumed to be present, based on its subsequent re-entry of the trap. After a bird has maintained its presence for 10 days all subsequent entries are ringed. This is done for each bird. The number of ringed entries for a column consitutes the stability index for that column or day. Usually the index is determined for each day in a given period, and the indices are averaged.

Bird	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	√	–	–	X	–	–	–	X	–	–	ⓧ	⊖	⊖	⊖	ⓧ	ⓧ	⊖	ⓧ
B		√	–	–	–	X	–	–	X	–	X	⊖	⊖	ⓧ	⊖	⊖	ⓧ	
C		√	X	–	–	X	–	X	–	–	–	ⓧ	⊖	ⓧ	⊖	ⓧ		
Stability index											1	3	3	3	3	3	2	1

Species differences in stability indices are shown in Table 7 for samples in 1965 and 1968, comprising 14,212 and 15,267 birds, respectively. The index was determined for each day in the manner just described and these daily indices averaged for the period, which included all the days in the given year when there was at least some banding activity with reference to the given species. These periods lasted on the order of 200 days.

Most stable of the populations (i.e., with the highest average stability indices) was that of the Grackles (Table 7). A simple analysis of variance yields the ratios (F) of variance between species to variance within species shown in the next-to-last column. These ratios are much larger than would be required for $p<0.01$. Thus the species samples differ significantly in both years, with Grackles and Starlings at the extremes of stability, and the Cowbirds and Red-wings intermediate.

TABLE 7
Average daily stability indices

	Grackle	Cowbird	Red-wing	Starling	F ratio	F necessary for $p<0.01$
1965	11.3	1.7	2.0	1.1	142	3.8
1968	14.6	3.6	4.2	0.8	75	3.8

The data on recoveries, discussed earlier, reveal a tendency for Grackles to remain in the Columbus area to a greater extent than do the other species. The stability indices show a more localized tendency to remain in the vicinity of the trap. It is probable that these two tendencies are related to the same factor—either topophilia or some more basic aspect of personality, as suggested earlier.

CAPTURES IN RESIDENTIAL *vs.* FARM AREAS

The comparative frequency of the species captured may vary with the location of the trap. In this respect, data are available for a comparison of a residential area (Station A) with a farm area (Station B) (Burtt and Giltz, 1971b). Station A was operated by one of the writers (Burtt) at his home from 1953 to 1963. It involved a house lot 145 feet by 76 feet in area. It was bounded on two sides by a hedge of *Viburnum americana*, *V. lantana*, Honeysuckle (*Lonicera* sp.,), and *Forsythia suspensa*, and the lawn was bluegrass and fescue. The traps included an "all-purpose" trap, as described in the Bird Banding Manual (U. S. Dept. of the Interior, 1972), two traps of the "maze" type, where the birds enter and cannot find their way out, and four traps of the type where the bird steps on a platform that trips the door. Station B was the decoy trap described earlier, located on the University Farm about a half mile distant from Station A.

Data used were for approximately a three-year period at each station: from January 1960 through September 1963 at Station A and from October 1963 through December 1966 at Station B. Table 8 shows the percentage of the different species of birds that were captured and banded at each station. For example, at Station A, 83 percent of the 207 birds banded are Grackles and 15 percent are Cowbirds. The most striking fact in the table is that Grackles constituted 83 percent of the birds captured at Station A and only 5 percent of those captured at Station B.

Several explanations have been considered for this preponderance of Grackles in the residential area. Perhaps they are less inclined to enter a decoy trap than to enter the more conventional traps. However, as shown earlier, they tend to *re-enter* the decoy trap much more frequently than do the other species. If some variable, such as lack of social tendency, minimizes their initial entry, it should also minimize their re-entry, which it obviously does not. It appears doubtful

TABLE 8
Birds banded at two stations one-half mile apart

	Grackles	Cowbirds	Red-wings	Starlings	Total No. Banded
Station A Residential Area	83%	15%	1%	1%	207
Station B Agricultural Area	5%	33%	23%	39%	50,269

that the type of trap accounts for the preponderance of Grackles in the residential area.

A more plausible explanation is that there is a comparatively larger Grackle population in the residential area than there is in the agricultural area. The assumption is made that the number of birds of a given species banded is proportional to the population of that species in the banding area. The Lincoln Index, which is widely used in estimating bird populations, is based on this assumption (Nunnelly, 1964). This larger population of Grackles in residential areas is further supported by the study of recoveries described earlier (Table 6). The "city limits" comprise, for the most part, residential areas, including many back yards and lawns.

One possible explanation for the population differential is nesting habitat. Grackles commonly use conifers and many conifers have been planted within a half mile of Station A, while there are none in the vicinity of Station B.

Food preference is another possibility. Grackles have been observed in large numbers foraging on lawns. It may be that the food found there is preferable to what is available in the farm crop area.

Another possible explanation is the general ecology of the residential area, which includes the people living there. Perhaps the Grackles have a greater flexibility in adapting to the appurtenances of "civilization." They may have less fear of people, or of traffic, or of city noises. This adaptability may reflect some aspects of Grackle personality.

SPECIES IN A BLACKBIRD ROOST

In March 1969, a blackbird roost five miles from the decoy trap was sprayed, by the Wildlife Service, with a wetting agent in a blackbird-control project, and many birds were killed. Of the banded birds recovered, 46 had been banded at the decoy trap. The first column of Table 9 shws that 67 percent of these 46 were Grackles. This large percentage could result from a preponderance of Grackles in the area. Hence, it was desirable to estimate the comparative fre-

TABLE 9
Banded birds recovered at a Blackbird roost following spraying in a Blackbird-control project in March, 1969

	Percent of Banded Birds Recovered	Percent of Birds Banded in March (1964–1969)
Grackle	67	2
Cowbird	0	39
Red-wing	11	8
Starling	22	51

quency of the four species in the area at that time of year. Such an estimate was made on the basis of the number of birds of each species banded in March over a six-year period (1964–1969). The second column of Table 9 shows that only two percent of these March birds are Grackles. With this small population of Grackles in the area, there is a comparatively large kill. This means that the small population of Grackles in the vicinity at that time of year tends to remain there in the roost to a greater extent than do the other species, or if they do leave, they return to the vicinity in a subsequent year. This behavior may be a matter of topophilia or of some aspect of Grackle personality related to topophilia.

DISCUSSION

The research described represents only a modest beginning in the study of bird personality. Further research, hopefully, will follow the pattern that has been used at the human level. A personality trait may not be a completely unitary type of behavior, but may comprise several components or "factors." Scores of as-yet-unidentified personality variables need to be correlated with each other and a factor analysis made of the resulting matrix of intercorrelations. Inspection of the factor loadings may then implement speculation as to the nature of the basic factors involved. This approach should ultimately provide considerable insight into the structure of bird personality.

SUMMARY

Several research projects conducted during the operation of a decoy trap and the banding of 100,000 blackbirds and Starlings point up the importance of personality, as defined here, as an explanatory principle in bird behavior.

An objective test for complacency-agitation reveals that Cowbirds are the most complacent and Starlings are the most agitated, while Grackles and Red-wings are intermediate. Female Red-wings are more complacent than are males, but Cowbirds show no sex difference in complacency. Adult male Red-wings and Cowbirds are more complacent than are young males. Red-wings are more agitated during the late season than they are earlier.

A rating scale for aggressiveness, based on the reaction of a bird in the hand to a standardized series of threatening gestures, indicates Grackles and Cowbirds to be the most aggressive, while Starlings and Red-wings are the least aggressive.

Grackles have the greatest tendency to repeat, i.e., re-enter the decoy trap. Female Red-wings and Cowbirds do more repeating than do males.

Recoveries of banded birds away from the banding station by other persons show that only Grackles have a large incidence of local recoveries. These may be in the year when banded or in a subsequent year. This behavior probably involves *topophilia* or an attachment to a given area. A *stability index*, based on numbers of individuals persisting in area for more than 10 days, shows that the Grackle population is far more stable than are the others. A larger proportion of Grackles than of the other blackbirds and Starlings is trapped in a residential area in comparison with an agricultural area. This trend may reflect a Grackle personality better adapted to civilization.

The kill at a blackbird roost a few miles from the trap, when it was sprayed with a wetting agent during a blackbird-control project, included a larger proportion of Grackles than would be expected from the presumed local population at that time of year.

In all these studies, if some personality characteristic was not measured directly, then aspects of personality emerged in the course of interpreting the results.

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Our Changing Fisheries. *S. Shapiro*, ed. U. S. Government Printing Office, Washington, D.C. 20402. 1971. 534 p. $9.00.

This reviewer was favorably impressed with this well-bound, indexed, profusely illustrated and timely volume. The editor has assembled a large group of experts to present many biological and economic aspects of the commercial fisheries, primarily in the United States. The book follows a logical organization, beginning with an introductory background of the problem, and then gives specific examples arranged on a geographic basis. Meaningful statistics such as the current United States fish consumption, by category, and our rank in the world in terms of supply and demand of fish products are also stated. It is a volume written for a wide audience. The editor skillfully uses excellent photographs (mainly in color) and deletes scientific names to bridge the gap between the scientist and layman.

The enigma of the sea belonging to no man, but its crop belonging to whoever legally harvests it is well documented. The enormous international problems faced with managing such a resource are well stated, from a past, present, and future approach. Herbert W. Graham's account of the historical assemblage of scientific knowledge of the life history of the eel and Floyd S. Ander's documentation of artificial cultivation are particularly informative.

The book has a few technical and style flaws. The continual reference to the Bureau of Commercial Fisheries is now out-dated. All of the functions of this defunct agency have now been transferred to the new National Marine Fisheries Service or to the Bureau of Sport Fisheries and Wildlife. The editor should have put the name and background of each author at the beginning of each chapter, instead of at the end. Almost all of the authors are from the same governmental agency, this reducing some of the value of the multi-writer approach. The editor has combined the probable different writing styles of each author into a uniform, single approach. However, this reviewer felt that the personality and character of the respective writers was somewhat sacrificed at the expense of uniformity. Despite this revision, some repetition of information exists between chapters. In addition, the title is misleading, because little consideration is directly given to the sport fisheries. The single sport fisheries photograph on p. 515 actually detracts from the excitement of this sport.

In summary, this book is a valuable asset as a reading and reference source for anyone interested in commercial fisheries. This volume will further reinforce the layman's interest in marine science. The illustrations, alone, make the $9.00 price a bargain.

Stephen H. Taub